So, now we're going to do a more detailed look at the specific properties of the different antibodies that make up the classes. Just as a reminder, you have this table in your notes that has a lot of the specifics about these different antibodies. What we're going to do, however, is look at some pictures of them. The first one we're going to look at is some drawings of the G class antibodies. This is one. All four of these have the three constant domains, the flexible hinge, and this is the standard secreted antibody that you use to fight most infections, especially active acute infections. When somebody puts an antibody up and does some kind of drawing, this is the type of antibody that they're typically representing. Now, if you'll notice, it comes in four different kinds. They're numbered one to four, and the numbering is sadly, I think, misleading because they really, the IG3 one here should really come first, then the IG1, then the two, and then the four. That is the order in which the constant regions are found in the gene and not at all coincidentally, that is the order sorted from strongest to most restrained of the responses that these antibodies tend to elicit. So, I have here on the next table that sort of reminds you what is the different functions of these class four antibodies. Now, let me go back and take another look at these things. If you see the one that's the strongest here, the IG3, very strong activator or complement very strong activator of neutrophils and macrophages, if you look, this one is very, very bendy, it has an extremely long hinge region, 11 disulfide bonds holding it together, and you might think there will be a relationship between the complement activation and the length of this region. But if I look at the next one down, this actually got a relatively short hinge region. The IgG1 is the second level and it's actually a pretty ordinary looking antibody. So, in any event, we have these four different kinds. They all recognize antigen in their CDRs or recognition sites at the tips of the arms, but the stem region is really where you find the adaptation for tweaking your immune systems response. All right. So, this is what the T cells basically tell the B cells to switch into which one of these things they should produce. The first antibody that's produced in the course of an infection is the M class antibody. If you'll recall, we've seen this guy before. Here is one of the single units you can see. It has the antigen binding sites at the Y. It's a rigid antibody with rigid bend and four constant domains. When it is first expressed at the beginning of an infection, it is secreted with the J chain shown here and in an association of typically five of these antibody units put together with disulfide bonds. What this antibody is, is a general all-purpose first responder. The J chain allows it to cross epithelium. The stems on this thing are strongly complement activating. It can bind to, again, whatever antigenic properties or the signature of the pathogen. What we will find is that this is the secreted form. Of course, the monomeric form is the one that you find embedded in the membrane. So, this is also, because it's the first antibody class expressed, the single unit here will be embedded in the membrane with a transmembrane region here at the FC stem, and this will be one of the two classes of antibodies that stick out of what is called the mature but naive B cell. That is the B cell that is first released from the plasma that's going around and looking for trouble. Okay. So, this thing is very good at finding large complex structures, activating complement, killing foreign cells, but it's not specifically adapted to one or the other types of infections the way the G class is. Our next antibody is the A class antibody. Now, if you'll notice, this thing also has a J chain, and that is associated with things being put into complexes. Typically, an A chain is secreted across membranes in complexes of two or sometimes three, although it can occur as a monomer in the plasma. Now, notice, while this has the J chain the way the M class does, it also has a hinge region instead of a rigid bend. So, this is in a sense, superficially, looks like a G class antibody, but in general has quite a different function. It occurs in two subclasses and it is a secreted antibody. It goes into mucus, tiers, saliva, breast milk, and you can actually make up to 15 grams of this a day. This is a protective antibody. You secret it into your digestive tract, into your lungs, into your reproductive tract, and the healthier you are, the better fed you are, the more of the starch you can make, and the better you are at preventing infections in the first place. In general, this does not produce a huge inflammatory response, does not activate complement, it's kind of there as a barrier to an assortment of pathogens you've encountered before that prevents you from getting sick and not make you sick in the course of fighting off an

infection. So, here we have the A class antibody. Again, has the hinge, has the J chain, patrol the epithelia. Now, of course in the race of the Red Queen, you can imagine that there are bacteria that are trying to do this in. One of the things that bacteria sometimes make is a protease that specifically attacks the hinge region here. So, they will fight this guy off. But of course then, if you have an M class antibody, that antibody should survive that treatment and still be able to give you some kind of protection against some extracellular pathogen. Now, this next one is a really interesting antibody. It is the E class antibody. Notice that it has a rigid bend the way the M class antibody does, and I've colored it in a similar way. But in reality, if you look at the amino acid sequences in the FC chain, you will find that they are very, very different from the M class antibody. This one only occurs as a monomer and it is there to take place in certain specific kinds of responses. Unlike the FC stems of, say, the G class or the M class antibodies, this FC stem will attach, in fact even pre-attach to the FC receptors of basophils, mast cells, and eosinophils. So, it is involved in what we call BAC Th2 restraining response against pathogens that are not in general giving you a lethal infection. This is also the antibody that you produce when you get allergies. That is, if you're allergic to pollen, if you're allergic to cat dander, you're allergic to it because these antibodies have some receptor at the front at the Y stems that pick up those proteins. Okay. It's a rare antibody, but it's a potent one. You might say, well, I wish I didn't have this thing at all, especially in the middle of the spring. So, what is this thing actually good for? Well, this is the antibody you use to fight off parasites, worms in particular in your GI tract. You also use it to fight off environmental pollutants. So, well, right now you might say heavens, how do I have something for environmental pollutant when, good grief, we've only had the industrial age for 200 years. It turns out that even thousands and thousands and thousands of years ago, human beings were exposed to wood smoke possibly. So, okay. A pollen grain is not a problem, but a mold spore is. So, this is again a protective antibody against a variety of low level threats in terms of environmental pollutants and parasitic infections. It's generally associated with the Th2 response, the more controlled response, the more restrained one, but nonetheless, a hostile and protective response. The final antibody looks just like a G class antibody but on the other hand, it's really not. This is the D class antibody, and you hardly ever see what I have shown here, the soluble form. Almost always, this declares antibody occurs as a membrane-bound form, has the transmembrane region here at the FC stem, and is found on the mature but naive B cell, along with the M class antibody. What we think this thing is doing is, because it can bend in the M class can't, it makes it a little bit easier for two antibodies IG receptors, in this case, to bind to the same antigen cross-link and set off a response. So, this guy with its flexible hinge seems to facilitate antigen recognition by a naive B cell, while, again, it superficially represents a G class antibody, it's a very unusual one, is rarely found in the plasma, and it seems to be basically there to assist in recognition on the mature but naive B cell. So, having talked about some of these functions with the specific antibodies, we're now going to look at them in action in the next section.